

Appl. No. 09/849,049
Amdt. Dated December 12, 2005
Reply to Office action of Sep. 4, 2003
Amendments to the claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A ~~bi-directional~~ cutting system ~~saw of the type~~ for use in singulation of substrates and dicing of wafers, comprising:

a first and a second linear transport means arranged parallel to each other; wherein each said the first transport means comprises comprising a first linear actuator and a first carrier support moveable by said the first linear actuator; wherein the second transport means comprises a second linear actuator and a second carrier support moveable by the second linear actuator; and wherein each of the first and second linear transport means has three sequential points serving as a load/unload station, a vision position station, and a singulation/cutting station for the first carrier support and the second carrier support;

means for positioning each said the first carrier support and the second carrier support sequentially from a the load/unload station to a the vision position station and then to a the singulation/cutting station; wherein each said the first carrier support and the second carrier support being reciprocally moveable back and forth move in an X-axis direction at said from and to the singulation/cutting station; and

singulation/cutting means for separating semiconductor type substrates/wafer devices one from another while mounted on said carrier support by cutting the substrate/wafer as it passes in both X directions; wherein the substrate/wafer is mounted on the carrier supports; and wherein simultaneously the cutting of a first the substrate/wafer on a the first/second carrier support on a first the first/second linear transport

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means ~~while simultaneously~~ may be done when the loading/unloading and positioning a ~~second~~ the substrate/wafer on a the second/first carrier support ready for cutting on a the second/first second linear transport means, thereby reducing lost cutting time to a minimum.

Claim 2 (currently amended): ~~A bi-directional cutting saw as set forth in~~
The cutting system of claim 1 wherein said substrate/wafer is a rectangular strip and said carrier support is adapted to receive an adapter plate and a gasket for supporting said strip on said carrier support.

Claim 3 (currently amended): ~~A bi-directional cutting saw as set forth in~~
The cutting system of claim 2 wherein said carrier support comprises means for rotating said strip exactly 90 degrees from a predetermined position.

Claim 4 (currently amended): ~~A bi-directional cutting saw as set forth in~~
The cutting system of claim 1 wherein said carrier support comprises means for vertically positioning ~~a substrate/wafer~~ substrates carriers.

Claim 5 (currently amended): ~~A bi-directional cutting saw as set forth in~~
The cutting system of claim 1 wherein said singulation cutting means comprising blade support means, and

a pair of counter-rotating saw blades mounted on said blade support means for vertical movement and for engaging one of said saw blades into engagement with a substrate/wafer when moved in a first X direction and for engagement with the other said saw blades when moved in a direction opposite to said first X direction.

Claim 6 (currently amended): ~~A bi-directional cutting saw as set forth in~~
The cutting system of claim 5 wherein said blade support means comprises a rocking frame mounted on a pivot shaft.

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Claim 7(currently amended): ~~A bi-directional cutting saw as set forth in~~
The cutting system of claim 6 wherein said pivot shaft is moveable in a
clockwise and/or a counter-clockwise position to position one of said
saw blades in a downward Z direction.

Claim 8 (currently amended): ~~A bi-directional saw cutting system for~~
singulating semiconductor devices from a substrate, comprising:

a pair of counter-rotating saw blades mounted on a moveable
frame positioned above ~~a~~ the substrate to be singulated,

transport means mounted on a base below said saw blades for
moving substrates to be singulated into engagement with one or the other
of said saw blades, wherein said transport means having front and rear
linear actuators arranged parallel to each other, and wherein each of the
front and rear linear actuators has three sequential stopping points
serving as a load/unload station, a vision position station, and a
singulation/cutting station;

a front substrate carrier support coupled to said front linear
actuator, and

a rear substrate carrier support coupled to said rear linear actuator,
wherein one of said substrate carrier supports being moveable is moved
transversely from a load and unload station to a vision positioning
station the load/unload station to the vision position station while the
other of said carrier supports is being reciprocally moved into
engagement with one and then the other of said pair of counter-rotating
saw blades.

Claim 9 (currently amended): ~~A bi-directional saw~~ The cutting system of
claim 8 which further includes means for vertically moving downward
one of said saw blades into engagement with a substrate to be sawn while
simultaneously vertically raising the other of said saw blades.

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Claim 10(currently amended): ~~A bi-directional saw~~ The cutting system of claim 9 wherein the further comprises a moveable frame on which the pair of counter-rotating saw blades are mounted is supported on a pivot shaft, and

Means for pivoting said frame on said pivot shaft to move one saw blade downward while simultaneously moving the other of said saw blades upward.

Claim 11 (currently amended):~~A bi-directional saw~~ The cutting system of claim 10 wherein said pivot shaft is mounted on and supported by a Y-axis gantry for supporting said saw blades in a Y-axis relative to a substrate on a substrate carrier support prior to sawing the substrate.

Claim 12 (currently amended): ~~The~~ A method for bi-directionally sawing a substrate, comprising the steps of:

providing a singulation saw with a plurality of rotating saw blades for sawing a substrate to separate individual devices one from the other, wherein at least one of plurality of rotating saw blades rotates ~~rotating one saw blade~~ in a clockwise direction and at least one of plurality of rotating saw blades rotates ~~the other saw blade~~ in a counter-clockwise direction,

moving the substrate in a first direction into engagement ~~for sawing with one of the saw blades blade rotating in one direction while moving in a first direction,~~ wherein the substrate is moved along one of a first and a second linear transport means arranged parallel to each other; wherein the first transport means comprises a first linear actuator and a first carrier support moveable by the first linear actuator; wherein the second transport means comprises a second linear actuator and a second carrier support moveable by the second linear actuator; wherein each of the first and second linear transport means has three sequential

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points serving as a load/unload station, a vision position station, and a singulation/cutting station for the first carrier support and the second carrier support; and wherein the first carrier support and the second carrier support reciprocally move in an X-axis direction from and to the singulation/cutting station; and

reversing the movement of the direction of the substrate and engaging ~~the other of said saw blades~~ one blade rotating in the opposite direction into engagement with the substrate for sawing, and

thereby sawing the substrate in opposite directions using the different saw blades ~~while sawing in opposite directions.~~

Claim 13 (currently amended): The method ~~as set forth in~~ of claim 12 wherein the step of providing a singulation saw further includes mounting said rotating saw blades on a pivoting frame,

moving the clockwise rotating saw blade into engagement with the substrate by pivoting the frame, and

simultaneously moving the cunter-clockwise rotating saw blade clear of engagement with the substrate.

Claim 14 (currently amended): The method ~~as set forth in~~ of claim 12 wherein the step of moving the substrate into engagement with one of the saw blades comprises plunging the cutting edge of the saw blade vertically into the edge of the substrate to be cut to start a new saw cut and moving the substrate horizontally to complete the saw cut.

Claim 15 (currently amended): The method ~~as set forth in~~ of claim 12 wherein the step of moving the substrate into engagement with one of the saw blades comprises raising the saw blade from the saw cut as soon as the saw blade finishes the saw cut in a reverse of a plunge cut while the cutting edge of the saw blade is in the saw cut.

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Claim 16 (currently amended): The method ~~as set forth in~~ of claim 13 wherein the steps of moving the substrate and reversing the movement of the substrate comprises positioning of two saw cutting blades over the edge of a substrate to be cut and removing the saw blade vertically as soon as the blade finishes a saw cut, then repeating the cutting sequence with the other saw blade while moving the substrate in the opposite direction.

Claim 17 (currently amended): A system for singulating substrates or wafers, comprising:

- a first moveable substrate carrier mounted on a first linear actuator,

- a second moveable substrate carrier mounted on a second linear actuator,

- means for independently controlling the theta or Z-motion of each of said substrate carriers,

- means for independently controlling the X-position of said substrate carrier on its linear actuator,

- said means for controlling the X-position of said substrate carriers comprising means for reciprocally moving one of said substrate carriers in a cutting station under a pair of saw blades mounted in the same cutting plane, and

- simultaneously positioning the other of said substrate carriers at an unload and loading station, then to a vision positioning station and then to a position outside of said cutting station ready to enter the cutting station when the substrate carrier in the cutting station moves out of the cutting station, thereby virtually eliminating any loss of cutting time, wherein said first and second linear actuators are parallel to each other and said substrate carriers are so large that they will not pass each other in a Y-axis direction, and

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means for positioning the substrate carrier or wafer carrier in a theta and/or Z-direction so that the carriers do not occupy the same space at the same time when passing each other in the X-axis direction when moving from one station to another.

Claim 18 (cancelled).

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